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Risk management in new product development process for fashion industry: Case study in hijab industry

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Abstract

The fashion industry is part of textile industry where innovation and creativity becomes essential factors to success. To satisfy customers, the fashion industry should always follows the fashion trend which makes the business very dynamic in nature. Because of this, fashion product ussualy have a short product life cycle which increase the challenges of new product development (NPD) process. Lots of NPD projects have been conducted by companies, but the success rate of NPD's project is still considered very low. This may due to the increased time and cost, difficulty in scheduling, and short product life cycle. All these factors could increase risks to the project, which call for a risk management practice to deal with this issue. Until now, there is still limited attetion on risk management in NPD which cover the whole NPD process in fashion industry especially for hijab fashion. Hijab fashion is a growing industry in Indonesia but not all companies in this industry are aware on their risks and how to mitagate them. Therefore, the purpose of this study was to apply risk management to fashion industry especially in hijab fashion by identifying and analizing risk factors and developing risk mitigation strategies. The present research involves three different hijab fashion enterprises.The method used in this research is Failure Mode Effect and Critically Analysis (FMECA) and House Of Risk (HOR). The data was collected through interview process by using a questionnaire. The research found critical risk events, critical risks agents and risk mitigation strategies. The contribution of this research is to provide framework that can be used to assist managers in implementing risk management and making effective mitigation strategies to be success in NPD for hijab industry.

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Keywords: Risk management; new product development; hijab industry; failure mode effect and critically analysis (FMECA); house of risk (HOR).

1. Introduction

Textile industry is one of Indonesian prominent industry which has high contribution to Indonesian economic.

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According to the Ministry of Trade, in 2008 textile industry, especially for fashion sector, contribute 44 % to Indonesian Gross Domestic Product (GDP)[1]. The growth of textile industry is also good. In 2011, for example, the increasing of Indonesian textiles and textile products industry (TPT) has reached 7,5 %. In addition, textile industry provide a lot of jobs for people ,for instance, In 2012 it provide job for 3,8 millions of people. Fashion industry is part of textile industry which is not simply about clothing, but it is also dealing with culture and lifestyle. Fashion industry needs to be developed as its contribution to the development of Indonesian economy. The development of fashion indutry is in line with Indonesian industrial development and economic improvement program [1]. The rapid growth of fashion industry has tighten the competition among the fashion companies creating more challenges for those industries to survive in the market. Some challenges faced by fashion companies are including the uncertain market demand, short product life cycle, rapid change of customer needs [2], a wide variety products, as well as, complex and length supply chain [3]. It is believed that to survive in market competition fashion company should establish an excelent new product development (NPD) process. However, according to Monsef [4], the succes of NPD project in several cases is very low, which the failure rate before the project finish could approaching 80%. This could be caused by some risks occur in different stages of NPD. In such circumtances, risk management is required to deal with these issues.

Most of Indonesian is Muslim. For Muslim women, it is compulsary to wear hijab, the reason why it is very common to see Indonesian women wearing hijab in their daily life. Hijab is the veil that wear to cover the head and chest. Unlike previous generation, nowadays, Indonesian women are wearing hijab in a more fashionable way. The trend of wearing fashionable hijab in Indonesia is growing, it makes the market big which becomes a good business opportunity for the fashion company to design and produce fashionable hijab for the Muslim customer.. The hijab product is produced throught a NPD process which like other NPD project will not free from risks and therefore need to be managed and mitigated. While risks is almost certain in NPD project, research on risk management for NPD is not many, even so, it is ussualy focused on one stage of the NPD process. Risk management in NPD is commonly focused on risk identification in design or project planning stages [5] [6] and less on risk in mitigation process. Research on risk mitigation strategies is still limited published in certain research area, for instance,in supply chain management research area, such as, the research carried out by [7], [8], [9], [10], [11], [12]. It is very rare to find one in NPD project on fashion industry especially for hijab industry. What risks are faced by hijab industry and how should the company manage their risks are become an interesting questions. Case studies are needed that explain the process of risk management in hijab industry.

The main purpose of this research, therefore, is to identify and analize critical risks factors at all stages of the NPD project in the fashion industry particularly in hijab industry and to determine appropriate risk mitigation strategies. The research has applied the integration between Failure Mode and Effect Analysis (FMECA) and House of Risk (HOR), which create a systematic and comprehensive framework that can help the manager identify risks and make more effective plan on mitigation strategies. The FMECA and HOR1 will be adopted to identify and analyze critical risk factors of NPD process. The result will become the input for HOR2 which is used to establish appropriate mitigation strategies. The process of risk identification and the development of mitigation strategies result in lots of data. These data need to be organized in such a way so it is easy to present the information for the decision making process. For this purpose, Dashboard application with PHP programming language will be used. Dashboard could help the researchers to visualy display all critical data and information, to monitor project risk management within the company and to assist in critical risk mitigation agent decision making.

2. Risks in New Product Development (NPD)

Risk can be defined as uncertainty that could create opportunities or threats for businesses [13]. According to [14], the NPD has two types of risks, namely internal risks (e.g.operational, technology and organization risks) and external risks (e.g. market risk and suppliers risk). Risk management is needed to effectively manage all of those risks, to avoid company from failure and hence to enhance the possibility of company success in NPD project. Risk management can help the decision maker to evaluate and to decide whether a project is feasible to execute considering the company capability including organizational structure, level of technology, the ability of human resources, financial condition, production level and marketing level [14]. Risk management on NPD could improve decisions, solve problems and assist in stabilizing the NPD program [15]. There have been many research focused in risk management,but, according to Park [14], most of that these research were still limited in conceptual framework, hence requires more research that discuss risk management applications in other stages of NPD.

There are many stages in NPD. The stages of NPD process in the fashion industry are include design process, modelling /prototype, detailed engineering, material selection, production processes and distribution [17]. In design process, products concept is designed by designer and stylish. The design of product then will be proceed to the next step to make prototype of the products. Next, in detailed engineering process the bill of materials (BOM) and the procurement of raw materials will be determined. In the production process and distribution, appropriate materials and method to produce and distribute the products will be selectd. An effective and efficient management of those all stages will result in the success of NPD project. Pujawan [12] on Fitrihana [16], for example, has revealed the key success factor of Zara clothing company in developing fashion products to the world fashion industry is due to the company ability to integrate the entire NPD processes. Moreover, early implementation of risk management in a NPD project is recommended in order to ensure the succeed of NPD project [6].

Risks in NPD process occur are trigered by many risk events. Example of risks events are include existence of the product substitutes and the product failed to give a value for the company [18]; length and complex supply chain [3]; the increasing of times and costs of product development [5]; the products design is not suitable for manufacturing [14]; the lack of organizational structure and the high cost of production [6], limited facilities and resources that support the activities of NPD process and poor project management skills [19]; rapid change of foreign exchange level and the lack of management structure control precisely [20]; the wrong team in product development and diversity of customer demand by product type [21]; the high level of uncertainty of market demand, short product life cycles, and rapid change of customer needs [2] etc.

3. Methodology

This research is applied to three companies, PT X, CV Y and UD Z. They represent, consecutively, large, medium and small companies in hijab industry. Risk management framework is adopted from Gray & Larson [13] while for the data processing, the integration between FMECA and HOR is used. The stages of the NPD in fashion industry especially in hijab industry were similar to NPD proces by Bandinelly [17] which include design, modelling/prototyping, engineering detail, material selection, and production and distribution.

The first step of risk management is risk identification where all of risks that may occur during NPD projects in hijab industry were identified. The risks in fashion industry were first identified through a literature study, which result in 56 risk factors related to different sources. These risks were then verified by stakeholders from the three companies including managing director/owner, personal assistant, head officer of development, public relation, operational production, human resource general affair and marketing.The risks were devided into four categories which are design and production category, financial category, management and marketing category. Beside risk factors, the risk identification process also determines risk events, the cause of the risks (risk agents), the impact of the risk events (severity) and the probability of risks (occurance) which are obtained through interview and brainstorming with the experts of the three companies.

The next step risk management process is risk assesment in which the risks will be analyzed and evaluated. In risk assesment process risks will be assessed in term of severity of impact, likelihood of occuring and controllability. The assessment process used FMECA and HOR1 to determine Aggregate Risk Potential (ARPj). ARP is calculated besed on Equation 1. It is obtained from the calculation of severity (Si), occurance (Oj) and the relationship between the risk agents and the risks (R_{ij}). R_{ij} has different scales that are 0, 1, 3, 9. Where 0 indicates no relationship between both of them, 1 indicates weak relationship, 3 and 9 indicate medium and strong relationships. The severity and occurance criteria are established based on the the interview with the experts from companies. The criteria are shown in Table 1 and Table 2.

$$\mathrm{ARP_j} = O_j \sum_i S_i \mathrm{x}\ R_{ij} \forall j \quad (1)$$

with j = 1, 2, ... m ; $R_{ij} \in \{0,1,3,9\}$ the relationship between risk agents j and risk events i.

$$\mathrm{S_i} = \sqrt[k]{s_{i1}\ X\ s_{i2}\ X \ldots X\ s_{ik}}\ \forall\ i\ ; \quad (2)$$

with i = 1, 2, ... n ; k = people assessment to-k

$\forall j$ = Cause of risks (Risks Agents) with j = 1, 2, ... m

$$O_j = \sqrt[k]{O_{j1}\ X\ O_{j2}\ X\ \ldots X\ O_{jk}}\ \forall\ j\ ; \quad (3)$$

with j = 1, 2, ... m ; k = people assessment to-k

Table 1 Criteria for severity

Rank	Criteria	Financial	Production	Company Goals	Company Images
1	Insignificant	(a) < 450 million (b) < 200 million (c) < 100 million	Production activities stop < 1 month	The impact on the achievement of the company goals can be ignored	The emergence of bad publicity in the internal environment
2	Minor	(a) ≥ IDR 450 million until ≤ 750 million (b) ≥ 200 million until 550 million (c) ≥ 100 million until 300 million	Production activities stop ≥ 1 month to < 3 months	Mild impact on the achievement of company goals	The emergence of bad publicity in the internal and eksternal environment
3	Moderate/ Medium	(a) ≥ IDR 750 million to ≤ 900 million (b) ≥ 550 million to 700 million (c) ≥ 300 million to 400 million	Production activities stop ≥ 3 months to < 6 months	Moderate impact on the achievement of company goals	The emergence of bad publicity in the local media
4	Major	(a) ≥ IDR 900 million to ≤ 1,3 billion (b) ≥ 700 million to 1 billion (c) ≥ 400 million to IDR 550 million	Production activities stop ≥ 6 months to < 12 months	Serious impact on the achievement of company goals	The emergence of bad publicity in the national media
5	Catastrophic	(a) IDR 1,3 billion or more (b) 1 billion or more (c) IDR 550 million or more	Production activities stop > 12 months	Very serious impact on the achievement of company goals	The emergence of bad publicity in the national media and lawsuits

Note : (a) PT X, (b) CV Y, (c) UD Z

Table 2 Criteria for occurrence

Rank	Criteria	Descriptions
1	Rare	Only occurs when extreme circumstances (1 time per 5 years)
2	Unlikely	Has not happened, but can occur at any time (1 time per 3 years)
3	Possible	Should have happened and might happen (1 time per 1 year)
4	Likely	Can happen easily and may appear on the state of the most (more than 5 times per 3 years)
5	Almost likely	Frequent and most common (more than 5 time per 1 year)

Another step from the analysis and evaluation process is risk mapping. In this step, the risks will be classified into extreme, high, medium and low risks. The classification is based on ARP value where for extreme risks the value is more or equal to 225, for high risks is less than 225 but more than 99, medium risks is between 50-99 and for low risks is less than 50. In this research, the dashboard application is used to provide visual presentation of the risk mapping.

The final risk management process is risk response process. In this process, the mitigation strategies to mitigate the critical risk agents (Ai) are formulated based on literature, depth interview, brainstorming and questionnaires with the experts of the companies. The risk mitigation strategies action planning are derived from calculation of ETDk using HOR2. Some formulas which are needed include:

1. Calculate the value of Total Effectiveness of Action (TEk)

$$TE_k = \sum_j ARP_j\ E_{jk}\ \forall j \quad (4)$$

The values of TE_k are obtained from calculation of ARP_j and E_{jk}. First, the relationship between risk agents and risk mitigation actions that relevant to risk agents (E_{jk}) should be determined. The criteria and scales which used were 0,1,3,9. Where, 0 indicates no relationship between both of them. 1 indicates weak

relationship, 3 and 9 indicates medium and strong relationship. All of the criteria and scales are based on depth interview and brainstorming with the expert of the companies.

2. Calculate the value of Difficulty of Performing (Dk) which is the difficulty level in implementing mitigation actions. The scales were 3, 4 and 5 where 3, 4 and 5 indicates easy, medium and difficult to implement, respectively.
3. Calculate the value of Effectiveness to Difficulty Ratio (ETD) of Action *k* to get appropriate risk mitigation strategies action planning.

$$ETD_k = \frac{TE_k}{D_k} \quad (5)$$

4. Research finding

This research use three case studies represent hijab industries in Indonesia. The result of depth interview with the experts reveal that while the companies have been conducting NPD for several times to maintain its position in the market and experienced the negtive effect of business uncertainty, a structured risk management has never been applied in their business process. NPD processes in these three case studies are include: design process, modelling / prototype, detailed engineering, material selection, production process and distribution which is most likely similar to NPD process in the Italian fashion industry [13].

Risk identification's by using FMECA and HOR1 result in 74 risk events, 90 risk agents, 51 critical risk events, 22 critical risk agents for all stages of the NPD process. The risks then is analyzed to define the risks that is critical and need more attention from the company. Critical risks were categorized into four, design and production, financial, management, and marketing. The number of critical risks for PT X is 10, while the critical risk for CV Y and UD Z are 7 and 5. The result of critical risk agents in the stages of NPD process from the three types of companies can be seen in Table 3. The risks can be presented by using dashboard aplication. The example of dasboard presentation is shown in Fig. 1.

Table 3. Critical risk agents of the three companies

Company	Code	Risk Agents	ARP	Rank	Stages of NPD Process (Ti)					Entities (Pi)						
					1	2	3	4	5	1	2	3	4	5	6	7
Design and Production																
PT X	AD12	Delays in delivering goods by suppliers	468	1			√		√		√	√		√		
	AD13	Limited facility and resource which support product planning process	384	2	√	√	√	√	√		√	√	√			
	AD31	Needs good coordination within the team	225	3	√	√	√	√	√	√	√	√	√			
CV Y	AD4	The design concept should always evolving	245	2	√					√						
	AD13	Limited facilities and resources that support the product planning activities	360	1	√	√	√	√	√	√						
	AD38	Workers still not consistent to keep the product quality on its maximal	225	3		√			√	√						
UD Z	AD43	Limited product function	420	1	√	√			√	√				√		√
Financial																
PT X	AF3	Considering the foreign currency	225	1		√		√	√	√	√	√				
UD Z	AF1	Rising prices of raw materials	252	1	√	√		√	√	√				√	√	
Management																
PT X	AM2	Lack of worker responsibilities	252	1		√	√		√		√	√		√		
CV Y	AM4	Lack of company attention on responding the emerging risks	225	1	√	√	√	√	√	√						
UD Z	AM4	Lack of company attention on responding the emerging risks	390	1	√	√	√	√	√	√				√	√	√

Marketing																
PT X	AP6	Fluctuation in market demand	423	3	√	√				√	√	√	√			
	AP7	Limited sales workers	270	5					√		√	√	√			
	AP8	Lack of sales qualification	324	4					√		√	√	√			
	AP11	Rapid growth of fashion and trend	720	1	√	√			√	√	√	√	√			
	AP21	Lack of product knowledge and customer preferences	432	2	√	√	√	√	√	√	√	√	√			
CV Y	AP2	Diversity of customer needs	378	2	√	√			√	√			√			
	AP6	Fluctuation in market demand	375	3	√				√	√			√			
	AP11	Rapid growth of fashion and trend	605	1	√	√		√	√	√			√			
UD Z	AP11	Rapid growth of fashion and trend	552	1	√	√	√	√	√	√				√	√	√
	AP16	Diversity of product's varian	388	2	√	√		√	√	√				√	√	√

Note:

- The stages of the NPD process in the hijab industries are include: design process, modelling / prototype, detailed engineering, material selection, production processes and distribution.
- The entities are include: managing director/owner, personal assistant, head of development, public relation, operational production, human resource general affair and marketing.

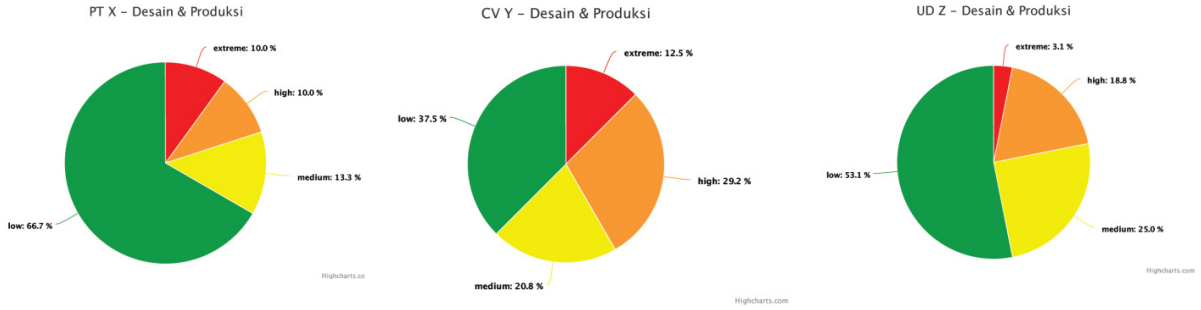

Fig. 1. The risk mapping for design and production category in the PT X, CV Y and UD Z

The result of risk mitigation strategies in relation to the critical risk agents for the three case studies are presented in Table 4. In general, it found that there is little commonality among the three case studies in term of critical risk agent and their strategies for risk mitigation. In design and production category, for example, it is found that the three companies have different opinions on what become the most critical risk agents for their companies. The exception is for limitation in facilities and resources that support the activities of product planning (AD13). This critical risk agent were experienced by two companies (PT X and CV Y). The absence of this critical risk agent in UD Z is because UD Z has sufficient amount of human resources (52 people), involves external production houses in addition to its full time employees, and only produce a limited products (20 models with 3000 pcs) which is conducted every four months. The mitigation strategy that were selected to deal with critical risk agent AD13 for PT X and CV Y are include: improving communication through the project (MD1), actively implement corporate culture (MD14), the product development team understand the technology well (MD17) and analysis of the weaknesses and strengths of the company (MD18). Among these mitigation strategies only MD14 is selected by both companies (PT and CV Y). PT X applies MD14 by building culture on cooperation, task responsibility, better integration of planning and scheduling processes. While, CV Y applies it by maximising production capacity every week. Applying the active corporate culture can help the organization to overcome some problems such as the limitation of resources [6].

In financial category, there also no commonality in terms of critical risk agents. While there two different critical risks agents are found in this category, namely, consider foreign currency (AF3) for PT X and rising prices of raw materials (AF1) for UD Z, however, there no critical risk agents is selected by CV Y. It may due to CV Y has better financial strategy including involvement of design, finance and marketing owners, ensures the safety investments and controls the financial resources.

In management category, commonality only found in critical risk agent AM4 (the lack of attention the company in response to emerging risks) which selected by two companies (CV Y and UD Z). AM4 is not founded at PT X because PT X always make periodic control for its business management. The mitigation strategy that were selected for critical risk agent AM4 for CV Y and UD Z are include keeping active company culture (MM1), improving communication

through the project (MM3), the risks of the project are clearly defined before beginning the project (MM5), the fast company respond to extreme circumstances in the NPD planning process (MM6), improved human resource capabilities in the technologies and recruited specialized human resources who understand the technologies (MM18).

In the marketing category, on the other hand, there is commonality of critical risk agent between the three companies. It is the development of fast fashion and trends (AP11). While for fluctuation in market demand (AP6), only occur for two companies (PT X and CV Y). The AP11 happen in all the companies because hijab industry have to follow fashion trends. The mitigation strategy for AP11 are include making a commitment to the customer (MP1), establishing effective communication with customers about the benefits of the product (MP2), analysing the external environment/market (MP6), effectively setting the marketing channel (MP9), determining the limit of risks product that will be accepted (MP10), evaluating the pricing strategies compared with the competitive and pricing products (MP13) and accelerating time to market or reducing product life cycle (MP15).

Moreover, there is the same mitigation strategy for PT X and UD Z which is MP6 whereas for CV Y and UD Z is MP13. The MP6 risk mitigation strategy at PT X is applied by building the effective marketing strategy which consists of product, place, price and promotion. Whereas for UD Z , the MP6 is implemented by creating own market which provides hijab embargo model with variations in colour and syar'i model to all market segments. For MP13, CV Y and UD Z have similar method which is evaluating the competitors pricing strategies and applying a price policy that can compete with the competitors' prices.

In addition, CV Y also has three other mitigation strategies, MP1, MP2 and MP10. The MP1 and MP2 is applied by building a good communication through social media, promotion event (i.e. one-day sale, workshops and interesting product design or pictures in instagram, webstore). Beside that, CV Y also expand its market share up to Kuala Lumpur and Singapore, which is already become loyal customers. Whereas for MP10 is applied by periodically monitoring customer preference on the hijab fashion, as well as, the creation of fashion trends.

For UD Z there are three other mitigation patterns namely MP9, MP13 and MP15. MP9 is applied by building the marketing channel, for instance, sending of more than 30,000 agents and more than 21 distributors from Batam to Papua, and build five new stores in Surabaya and Bandung. MP15 is carried out by selling certain products in the special days and accelerating the launch of the new catalogue product.

Table 4. The result of critical risk agents and risk mitigation strategies in the NPD business process in the three case studies

Categories	Companies	Critical risk agents code	Risk mitigation strategies
Design and Production	**PT X**	AD12	MD11
		AD13	MD1, MD14, MD17
		AD31	MD1, MD14
	CV Y	AD4	MD5
		AD13	MD14, MD18
		AD38	MD15
	UD Z	AD43	MD2, MD5, MD7, MD12, MD16, MD19
Finance	**PT X**	AF3	MF5, MF7
	UD Z	AF1	MF2, MF5, MF7
Management	**PT X**	AM2	MM1, MM6
	CV Y	AM4	MM1, MM3, MM6
	UD Z	AM4	MM5, MM6, MM8
Marketing	**PT X**	AP6	MP4, MP6
		AP7	MP4
		AP8	MP4, MP7
		AP11	MP6
		AP21	MP4, MP6, MP7
	CV Y	AP2	MP1, MP2, MP13
		AP6	MP1, MP2, MP10
		AP11	MP1, MP2, MP10, MP13
	UD Z	AP11	MP6, MP9, MP13, MP15
		AP16	MP6, MP9

Note :

MD2 Market research in the form of measuring the value of a product from the customer's perspective.
MD7 Periodic estimation and detailed estimation of the entire project.
MD16 Anticipate changes in technology and estimate product life cycle.
MD19 Simultaneous Engineering (change the scope of the project and modify the objectives of the project).

MD12	Achieving balance between the limited resources (i.e. time, cost and quality)
MD5	Specifying products with higher quality
MF5	Better financial predictions
MF7	Analysis of strengths and weaknesses of the company.
MF2	Have substitute of supplier.
MM1	Applying an active corporate culture
MM6	The company can respond quickly to extreme circumstances in the planning process of new product development.
MM3	Improved communication through the project.
MM5	Defining more clearly the risk of the project before starting the project.
MM8	Enhance human resource capabilities in the field of technology and specialized human resources who understand recruiting technologies for the benefit of maintenance.
MP2	Improve human resource capabilities in the field of technology and recruiting specialized human resources who understand the technology for the benefit of maintenance. Build effective communication with customers about the advantages of the product
MP1	Make a commitment to customer
MP10	Specify limits on the amount of risk that the product will be accepted
MP13	Evaluation pricing strategy
MP9	Better setting on marketing channel
MP6	Analysis of the external environment /market (i.e.competitors, customers).
MP15	Accelerate time to market, reduced product life cycles

5. Conclusion and future research

New product development project is a risky process. A structural risk management in hijab industry, especially for small medium enterprise, is not a common practice. The research found that there are 9 critical risk events, 4 common critical risks agents and 18 risk mitigation strategies in the three company under study. The risk management framework used in this research can be applied to assist manager in implementing risk management and making effective mitigation strategies in NPD for hijab industry. For future research, the research can be extended to analyze mitigation strategies that cover all risk agents, not only the critical one, that occur in all stages of NPD process. Moreover, for future research the case studies need to be clustered, where in each cluster consists of companies which have more similar characteristic to be able to make generalization.

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